Fusion: The Inis Meain Knitting Company and University of Ulster Collaboration Project

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Comparison of Different Yarns for Stab Resistant Knitted Fabrics

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Introduction

Stab resistant textiles are most often produced from woven fabrics. For a jacket which should be used every day by specially endangered occupation groups, such as bus drivers, teachers etc., and people living in dangerous areas, a woven garment, however, may be too stiff and not flexible enough to be worn without any limitations to the wearers' movements.

Thus in a recent research project, a stab resistant knitted jacket is under development. The stab resistance of knitted fabrics produced from different yarns is examined according to the VPAM test instruction "Stich- und Schlagschutz" and compared with the stab resistance of an aramide nonwoven [1].

The presentation gives an overview on recent results, comparing various yarn constructions combining common fibers like wool and high-tenacity, cut-resistant and other special fibers with knitted fabrics produced from pure high-tenacity yarns. It shows the influence of washing on the stab resistance of the textiles and examines the effect of the knitted fabric orientation with respect to the blade. While former experiments also compared different knitted structures, this presentation concentrates on double face fabrics only to evaluate the influence of the yarn variation alone [2].

Our experiments show that, depending on the most important comfort properties, such as the weight of a jacket, the thickness or the bending stiffness, different yarns give the best results. Apparently, taking all these factors into account, a compromise between acceptable comfort properties and sufficient stab resistance can be found for various degrees of necessary protection.

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Multiaxial Tensile Testing of Textile Fabrics

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The textile fabrics are structures produced by the characteristic interlacing of the yarns. The type of the structure results in a usually non-isotropic mechanical behaviour. The trivial tensile tests are limited in the warp and weft directions in the case of woven fabrics or in the bursting test in the case of knitted fabrics. Bursting test is considered as a multi-directional tensile test. The basic aim of that test is the determination of the breaking strength. Both testing methods with the different load application, cannot give enough information about the directional mechanical behaviour of the fabric. The breaking strength is an important information, however the low-stress testing gives important data necessary for the implementation of the textile fabrics in technical and precise applications especially if it could be measured in many directions and not only in the two of them. The related literature review gives an idea of the importance of the multiaxial testing (and not only loading) of the textile fabrics. The earlier publications focus on the measurements for technical applications of the textile fabrics [1,2]. The work done in the technical textiles and composites area continues until today [3-5]. Two very important works appeared recently [6,7]. Ozipek has correlated various methods for the determination of bi/multi axial loading and testing of fabrics. Lima reports the construction of a multi-axial in plane tester of fabrics [7].

In the frame of the current work a new device has been developed for the multi-axial testing of the textile fabrics. In the first test weft and warp knitted fabrics have been used for the determination of the performance of the testing method. The tester is capable for the measurement of the mechanical behaviour of the fabrics on four axes and on eight directions.

The first results of the new measuring setup are promising and the investigation continues for the correlation and the evaluation of the results.

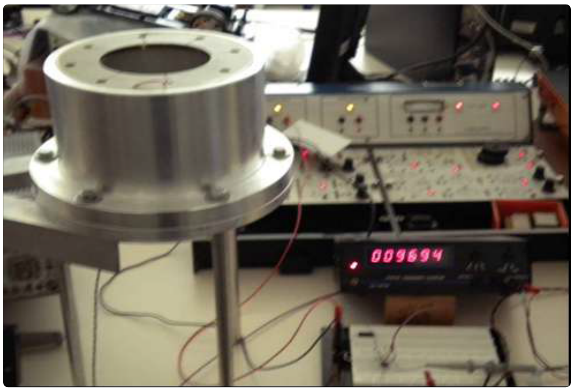

Figure 1: The multiaxial tester.

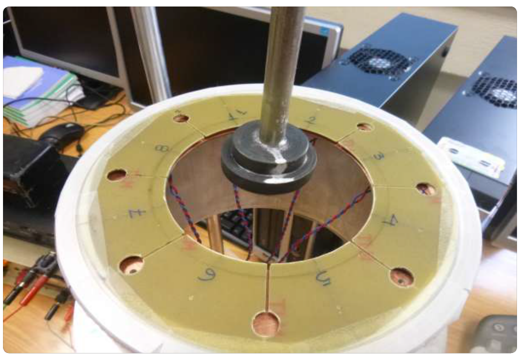

Figure 2: Detail of the measuring sectors.

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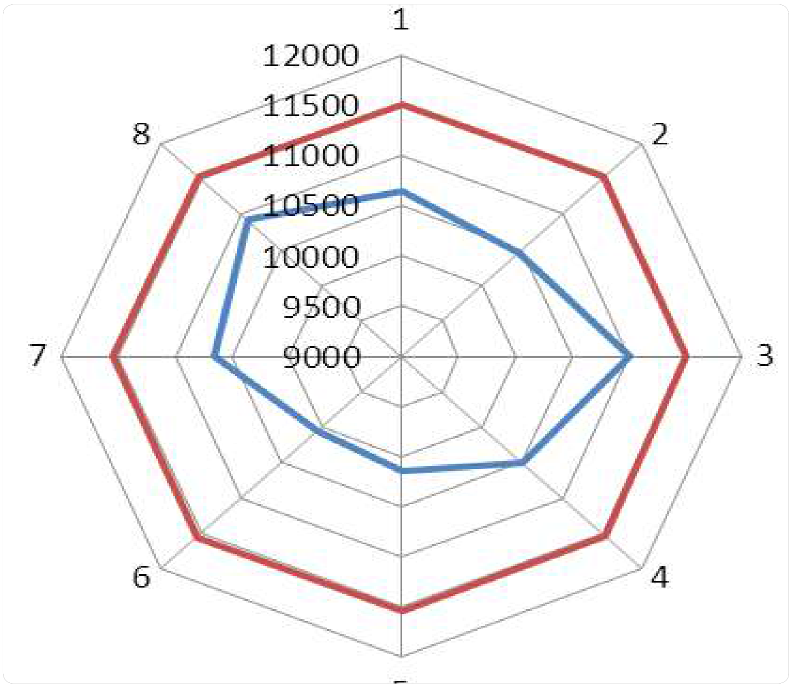

Figure 3: Warp knitted fabric.

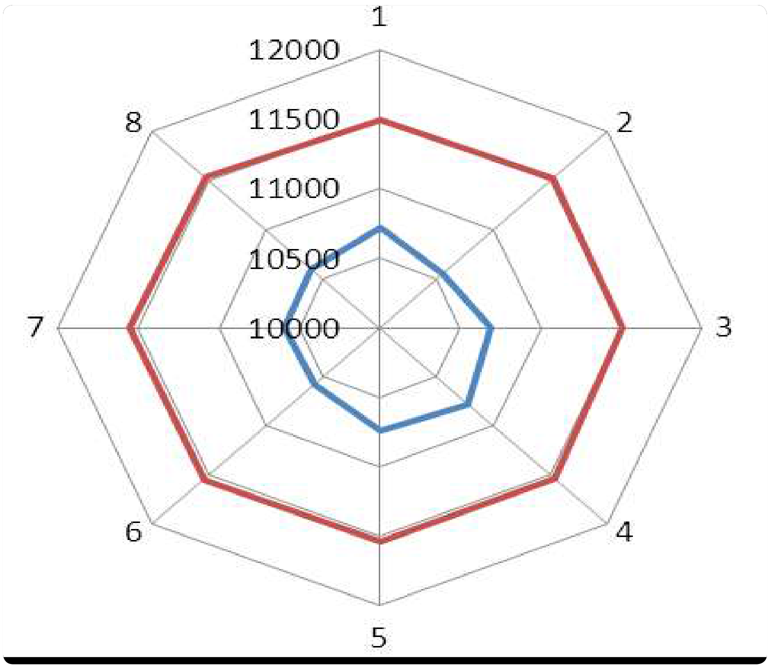

Figure 4: Weft knitted fabric.

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About the 3D Modelling of Jacquard Warp Knitted Structures

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The aim of this work is to present some theoretical considerations and modelling issues, connected with the three dimensional modelling of jacquard warp knitted structures. The three dimensional modelling of general warp knitted structures is a very complex task, which requires several steps to be performed in the right way. The algorithms, implemented into industrial software are based on calculations of the key points of the yarn geometry, based on some topological rules. Such pure geometrical models cannot give mechanically accurate presentation of the structure and requires some refinement steps.

This paper presents an extension of the previous works of the authors, which allows the geometrical modelling of jacquard warp knitted structures. Jacquard structures have higher complexity then the normal warp knitted structures, because the single needles of each jacquard guide have additional degree of freedom to change their position.

This additional degree of freedom leads to several tasks, which has to be solved, before the warp knitted structure is simulated:1) Definition of the warp knitting program for each guide and each needle of the guide in form, which is readable for the user and understandable for the computer; 2) Extension of the available models so that the yarns of each guide build loops and the rules are applied per guide and not per guide bar.

Furthermore some extensions of the presented mechanical models are applied in order the generated structure to be refined under the influence of the forces in the yarns to make the model more accurate.

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Loop Length Model of Fillet Structure

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Introduction

It is well known, that unit element of a knit structure is a loop. The loop configuration that is obtained in the knit depends on both qualitative and quantitative factors, the most important of which is the loop length. The loop configuration in the knit fabric of same interloopingfrom yarns of the same composition and same linear density is different and varies depending on the loop length. Thus, it is necessary to have a geometrical model of knitted loop configuration.

Few studies have been undertaken on the geometry of warp-knitted structures. The first geometrical model for warp knitted structures was quite simple model, in which the unit stitch shape consisted of semi-circle plus two converging straight legs and straight underlap section [1]. Second geometrical model of loop configuration was presented and improved by Grosberg for two bar warp knitted fabric [2]. It is based on physical configuration of the yarn. He assumed that the loop and underlap are effectively isolated from each other by friction, the root end of the loop lays at the widest section of the previous loop and the underlap is a part of a circle. Other geometrical model, in which loop was described by the sum of lines, parts of circles or ellipses, was proposed by Dalidovich for single bar warp knit structure [3]. He assumed that yarn has same diameter, deformation property and a circle in the section at each part of loop. These models are flat mostly, but at real knit structure loops are unfolded, bent and curved. So it is logical to represent them as spatial curves in 3D model.

General 3D loop and underlap models for basic two-bar full-set warp knitted structureswere developed by CAD program to obtain a three dimensional loop model that is suitable for visual computer representation of warp-knitted structures [4]. A 3D straight line model also should be used to predict the behavior of two-guide-bar warp knit fabric [5]. The accurate calculation of the run-in values verifies the proposed 3D loop models. But all these models were developed for full-set basic warp knit structures.

Also, it is well known, that net warp knitted fabric can be produced by using half-set two-guide-bar fillet interlooping. However, few loop configurations differ by size, form and shape in such structure [6]. In previous study, Ermolenko presented 3D loop models of net knit structure with hexagonal cell which is formed by alternation of tricot and atlas courses at repeat [7]. The aim of this research is to develop our loop model for net knit structure with hexagonal cell which is formed by alternation of tricot and chain courses. Vertical ribs of such net structure consist of tricot closed loops of identical configuration while diagonal ribs consist of tricot and chain loops of different type, shape and form. In this study each loop is presented as sum of planar and spatiallines, the length of which can be easily calculated by the well-known formulas. Numerical dependences for loop length calculation are determined as a result of mathematical transformations.

To verify the suggested model few variants of fillet warp knit structures were produced from polyester yarn. The investigation showed that theoretical average loop length of repeat corresponds to experimental value. It is concluded that the model can predict geometrical properties of half set two guide bar warp knitted fabric.

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A Multicriteria Decision Approach on Physical Properties of Socks Made from Different Fiber Types

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Introduction

During the daily life, owing to the fact that socks are connected with skin and shoes directly, they are subjected to more physical forces than other types of garments. As a result, they need to perform better physical characteristics than the others. For this purpose, in this study, a multicriteria decision making method, TOPSIS, was used in order to select the sock with best physical properties. A decision making problem is the process of finding the best option from all of the feasible alternatives. Multi-criteria decision making may be considered as a complex and dynamic process that includes one managerial level and one engineering level. TOPSIS is a kind of multi-criteria method to identify solutions from a finite set of alternatives. The basic principle is that the chosen alternative should have the shortest distance from the positive ideal solution and the farthest distance from the negative ideal solution [1-4]. New regenerated fibers such as modal, micro modal, bamboo, soybean and chitosan were selected for the study. Also, due to the limited number of studies about the performances of these fibers, in an intention to compare their properties with conventional ones, cotton and viscose were also edited to the study. Unlike ordinary socks, nylon and elasthane were not utilized in the production of the plain jersey socks for the work in an attempt to investigate the effect of fiber type on physical properties of the samples. The socks were produced at the same knitting settings. For performing the TOPSIS evaluation; weight loss, bursting strength, width wise and lengthwise dimensional stability were taken as a weight. Analytic hierarchy process was used to determine the relative weights of four decision criteria according to their relative importance for fabric performance. The detail of the fabric physical properties is given in Table 1.

Table 1: Fabric properties

	Weight loss (%)	Bursting strength (kg/cm²)	Widthwise shrinkage of the socks (%)	Lengthwise shrinkage of the socks (%)
Cotton	7.04	6.0	-4.84	-10.94
Modal	9.80	4.2	1.25	-5.31
Viscose	5.14	4.8	-0.16	-14.69
Micro modal	19.00	4.8	-2.97	-8.75
Bamboo	6.88	3.8	-7.50	-10.31
Chitosan	5.21	4.7	-4.06	-6.72
Soybean	3.86	7.0	-5.00	-11.25

The multicriteria approach showed that socks made from modal fiber are the best and preferable ones from over all. They were followed by the socks made from viscose and chitosan fibers. On the other hand, it was the bamboo socks which offered worse physical properties. Table 2 shows the preference order of alternatives.

Table 2: Preference order of alternatives

Fabrics	d+	d-	Relative closeness	Rank
Soybean	0.0735	0.2461	0.77	1
Viscose	0.0787	0.2249	0.74	2
Chitosan	0.0884	0.2153	0.71	3
Cotton	0.0902	0.1927	0.68	4
Modal	0.1180	0.1739	0.60	5
Bamboo	0.1395	0.1833	0.57	6
Micro modal	0.2405	0.0630	0.21	7

In this study, it was shown that TOPSIS can be a beneficial tool for this kind of researches. By using TOPSIS, a single ranking taking into account preferences of the decision-maker and priorities arranged according to the final goal can be obtained.

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Modelling of Porosity in Knitted Fabrics

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Introduction

Air permeability is often used in evaluating and comparing the "breathability" of various fabrics (coated and uncoated) for end uses such as raincoats, tents, and uniform shirtings. Also, it helps in evaluating the performance of parachutes sails, vacuum cleaners, air bags, sail cloth, and industrial filter fabrics [1-3]. Air permeability is defined as the volume of air (in liters) that is passed in 1 min through 100 cm (10 cmx10 cm) of the fabric at a pressure difference of 10 mm head of water [4].

This value has significance with respect to the usage area. Since knitted fabrics have a loop structure, they have more pores than woven fabrics; therefore, in general, the air permeability of knitted fabrics is higher than that of woven fabrics of the same weight (Figure 1). In this study, it has been attempted to establish a theoretical model for the porosity and predicted air permeability of plain knitted fabrics. A theoretical model was created to predict the porosity and air permeability of a knitted structure depending on the geometrical parameters, such as the courses per cm, wales per cm, stitch length, fabric thickness, yarn count, diameter of yarn and fiber density. For this purpose, a theoretical model of porous systems based on D'Arcy's law was used, the validity of which was confirmed by experimental results using 100% cotton plain knitted fabrics produced from ring and compact yarns of different yarn number linear density and tightness.

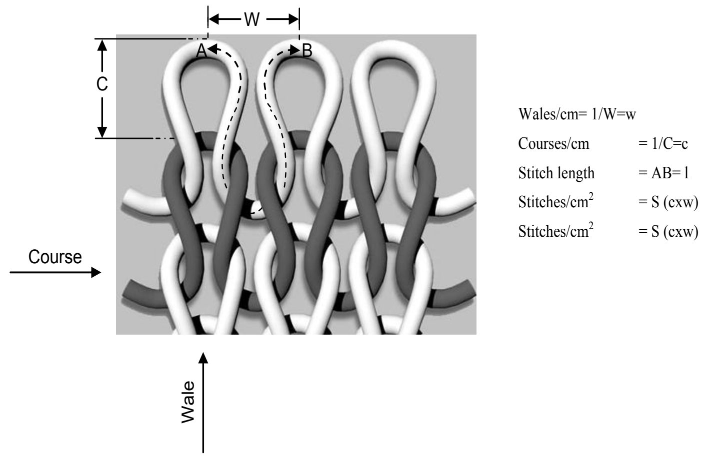

Figure 1: Representation of a plain knitted fabric

Establishing a more complex theory to express air permeability related to all fabric parameters will have difficulties. To simplify the matter, certain important parameters such as the pore of the fabric were taken into account in the calculation of air permeability. Three factors are mainly considered that are related to the pores in fabrics.

1) Cross-sectional area of each pore

2) Depth of each pore or the thickness of the fabric and

3) The number of pores per unit area or the number of courses and wales per unit area.

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In this work, these parameters are considered to develop a theoretical model for porosity and air permeability.

Conclusion: An experimental study was carried out to develop a theoretical model to predict air permeability values for knitted fabrics. The theoretical model predicts the value of the air permeability using the pore size and some fabric properties before manufacturing. D'Arcy's formulation was used to establish an equation expressing the relationship between the air permeability of knitted fabrics and fabric structure parameters. Due to the differences between ideal and real geometry and the random variation of the fabric structure, there are no exact dependences between experimental air permeability and predicted air permeability values. However, the closeness of the results of predictions based on calculated values from the theoretical model and experimental values show that our model can be successfully used for the prediction of the air permeability of knitted fabrics (R2 = 0.87). This model is simple and efficient.

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A Study on a Fault Detection System for Circular Knitting Machines

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Abstract

Fabric control process has a great importance and it is applied as a standard procedure in knitting factories. The ideal solution for the fabric control is to detect faults during the knitting process. In this study, it is aimed to develop a control system for circular knitting machines to detect and record faults occurred during the knitting process.

Introduction

Fabric control has a great importance in many years and extensive researches have been achieved on this subject. Tellerman and Stream (1964) invented a fault detection and stop-motion system for knitting machines and more particularly involved an electronic control circuit for stopping a knitting machine when a fault occurs [1]. Rosenquist et al. have developed a detector for controlling operation of the cylinder of a circular knitting machine. The logic circuit includes a timer and counting mechanism for stopping rotation of the machine cylinder if a predetermined number of signals are emitted within a predetermined time period [2]. Anagnostopoulos et al. have reported that faults had traditionally been detected by human visual inspection; however, human inspection was time consuming and could not achieve a high level of accuracy. In their work, they have described the software core for fabric inspection on the basis of simple image-processing operations [3]. Catarino et al. have developed a system for knitting process monitoring and fault detection on circular knitting machines [4].

Description of the System

In knitting factories, generally used method for fabric control is based on the visual inspection of the fabrics on the illuminated control tables. When the number of defects in the fabric exceeds a certain limit, the whole fabric is regarded as second quality. Consequently, this fabric control method causes a significant amount of material loss besides labor and time loss.

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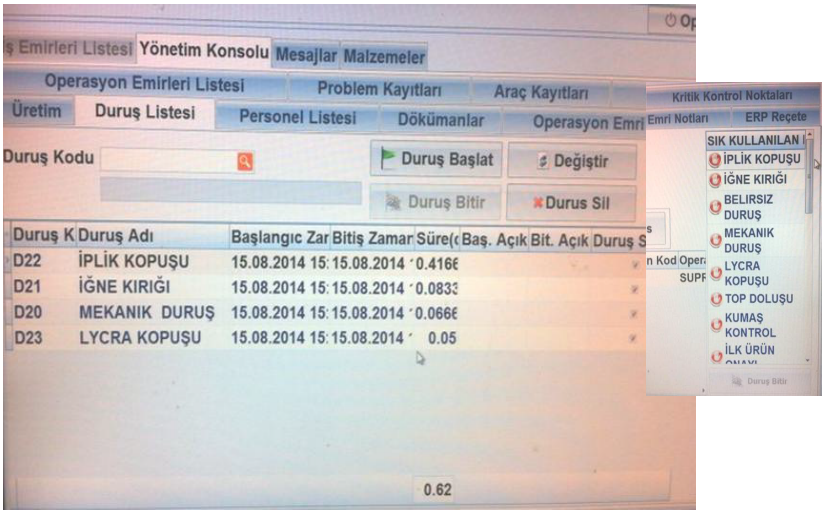
The ideal solution for the fabric control is to detect faults during the knitting process. By detecting and eliminating the fabric faults during the production, knitting industry would gain many advantages in terms of decrease in cost and energy consumption beside increase in productivity. Furthermore, the detection of the number and duration of the stops occurred during the knitting process is essential to evaluate the productivity of the process. These considerations evince the importance and necessity of the automation systems for the process control and fault detection.

In this study, it is aimed to develop a control system for circular knitting machines to detect and record faults occurred during the knitting process. When the process stops, the system enables the worker to record the cause of the fault on the touch screen with one move. The cause of the defect, such as yarn breakage or needle breakage, and its location will be detected and recorded during the knitting process in this way. The system also allows the integration with the automation system available in the factory.



Conclusion:

The advantages of this system can be summarized as following:

- The time spent for recording the fault information has been decreased. Therefore the number of the machines in control of a worker can be increased.
- With the elimination of the risks regarding the negligence of the worker, accurate data acquisition has been provided.
- With the online data flow to the quality and/or production responsible person, the productivity of the plant can be kept under control.

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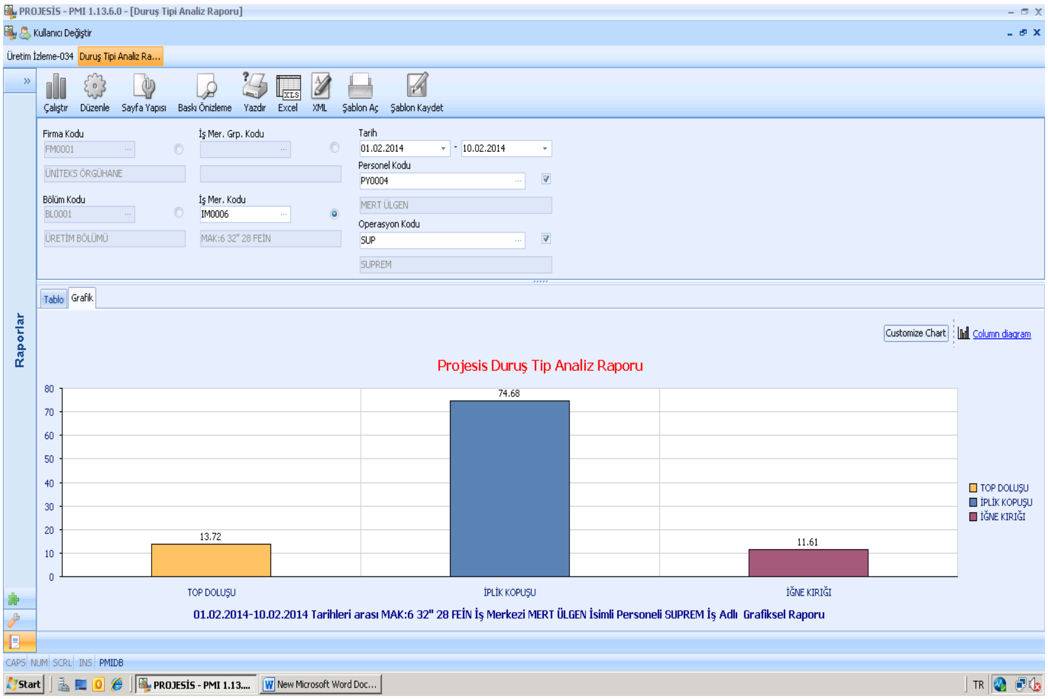
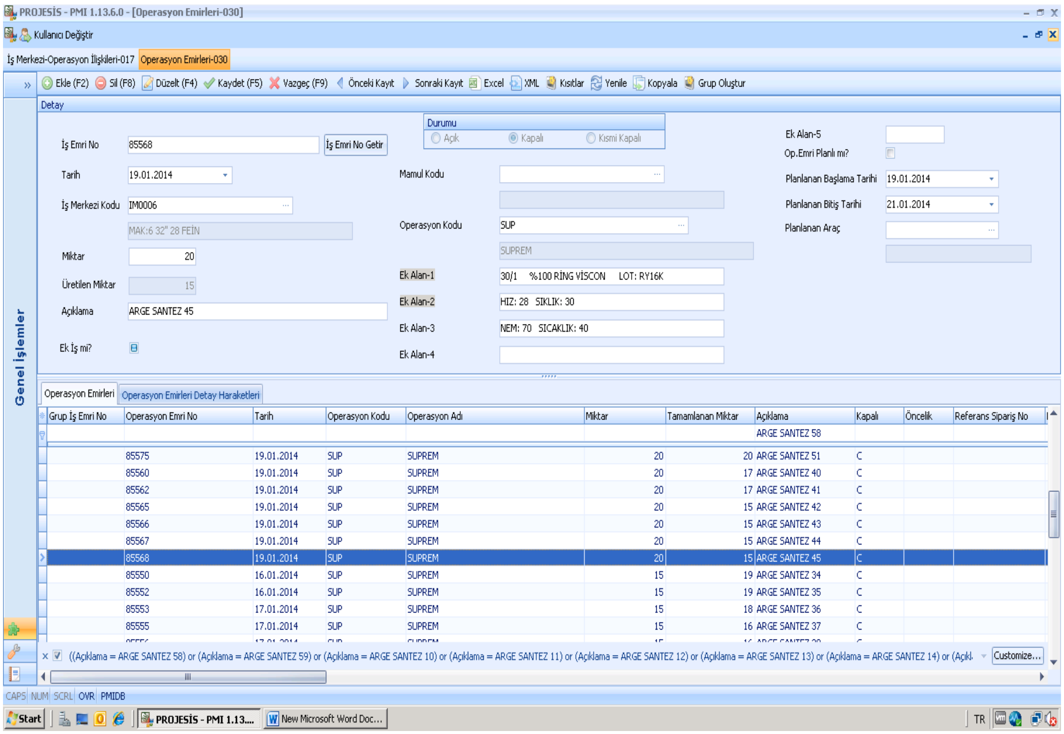


- Owing to the integration with the automation system available in the factory, the flow of the work orders and plans has become faster and the data storage has got easier.



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Material - Construction – Design Concept: The Challenges and Advantages of "Knitted Wool Couture"

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Most people still associate things like women's hobby, woolen socks, elderly ladies in rocking chairs and coziness to the term knitting; here the potential and variety of offers of knitted goods is seldom considered.

To confront this one-sided view was the motivation for the exhibition "Unravel – Knitwear in Fashion" in the fashion museum in Antwerp in 2011: "… It is too often overlooked that it (knitwear) can also be something highly fashionable, experimental and a daring choice for fashion designers. Body hugging cling, jersey sportswear, raw knits, sculptural volumes, lace-like body nets, the possibilities of knitting make an endless source of inspiration for fashion designers [1].

In design, especially the knitting technique offers an extraordinary gripping starting point. This is because the design process starts with the yarn, the thread, instead of with an already existing textile fabric and the designing and shaping of fabric and form can basically be defined and developed as with woven goods. Thus, knitting design is the interface between fashion and textile design and allows for a much more-in-depth involvement with the material than classical fashion design. The problem is that most of the designers in the fashion business are not used to work with knitting techniques. Something we want to change.

When in 2012, The Woolmark Company selected us to participate with a group of Master Students at the Wool School Contest, we were very happy to work out knitted styles with the technical support of a Cooperation partner, the Fashion Label Marc Cain (Figures 1 and 2). The Wool School Project is part of The Campaign for Wool that is a global endeavor initiated by its patron, His Royal Highness, The Prince of Wales, in order to raise awareness amongst consumers about the unique, natural and sustainable benefits offered by wool.

Our goal: We wanted to do something different, to what people would expect us to do but also show the technical and design competences and possibilities of our students and university.

The presentation gives an impression of our on special project "Knitted Wool Couture", that shows that High Class Woolen Yarns, Sustainable Textile Design and Knitting Technology are a perfectly matching together to create Fashionable Haute Couture on a high level [2-5] (Figure 3).

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Figure 1: Models of the winning team of the “Wool School” Competion in the display window of the Marc Cain Stores, Düsseldorf (Photo: Sharabati, 2012).

Figure 2: Experimental artworks of the participating students of the Master Course “Textile Products” of Niederrhein University. (Photo: Windgassen, 2012).

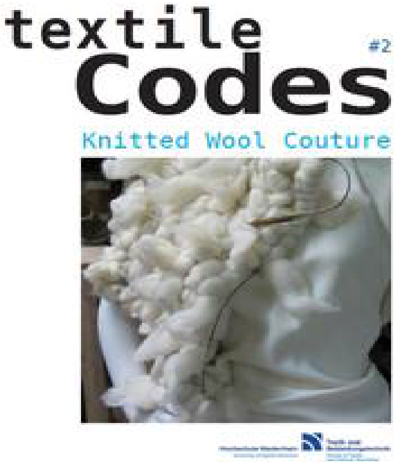

Figure 3: Textile Codes #2, “Knitted Wool Couture”.

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Forecasting of Integrated Double-Layer Knitted Fabric Quality Metrics

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Abstract

Production of integrated double-layer knitted thermal underwear for specified functional properties requires a comprehensive analysis of interaction the parameters of the process of knitting and quality assessment of the finished knitted fabric. Such problems, which considers multiple interconnected quality indicators are solved using mathematical optimization and involve the use of modern computer technology. Use of mathematical optimizing means and methods for research and mathematical description of the process not only provides an objective basis for the engineering, but also allows to predict the functional properties of knitwear and to manage the knitting process in order to find the optimal variant of the process.

Introduction

The aim of research is to develop a mathematical algorithm of parameters structure engineering and functional properties of knitted fabrics, as well as rational technological modes of its production on the basis of modern computing application. The problem put by the mathematical planning of experiments method is solved, which allows optimizing the technological processes in the course of the experiment with determined set of parameters [1,3].

For the functional underwear manufacture we have proposed a double-layer weft knitting structure with press connection layers by basic yarns. To give the fabric its poly functionality one layer formed from a hydrophilic kind of raw material, namely of a cotton yarn and the other layer, and the connecting elements - hydrophobic: modified polyester or polypropylene yarn.

On the basis of the realized full three-factor experiment [4] revealed the influence character of knitting parameters on the structure parameters integrated double-layer knitwear and its physical and mechanical properties. With the use of the method of data statistical manipulation install the mathematical regressions that describe the correlation between the knitting parameters and quality knitwear metrics. On the basis of these regressions developed a specialized computer program [2], which allows to computer design the overall knitting turnaround from set parameters of knitting equipment to the parameters of its structure and properties. In basis of the solution algorithm the multi criterion optimal control problem put simplex method of linear programming.

Using the developed software product provides a search solution of rational technological modes manufacturing of the integrated double-layer knitted fabric for functional underwear with the given structure parameters and properties and to reduce material costs to development and manufacturing application, increase labor and equipment productivity, and efficiently using a knitting machine and raw materials capabilities. Optimization of quality metrics and process producing of knitted fabrics for functional purpose by computer aids provides a significant economic effect and is a component of the successful functioning of any modern knitting enterprises.

Keywords: Integrated knitted fabric; Double-layer knitted thermal underwear; Linear programming; Simplex method

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Knitted Three-Dimensional Structures for Technical Textiles Applications

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Abstract

Technical textiles market worldwide was forecast to grow by 4% per annum between 2002 and 2010. As a result, in 2010, the technical textiles and industrial nonwovens sector consumed some 23.8 million tonnes of fibre – up from 16.7 million tonnes in 2000 and a value of US $ 90 billion – and had a value of US $ 126 billion. According to the author's estimates, the world technical textiles market was worth US $ 255 billion in 2013.

Knitted fabric production for technical textiles showed an overall growth of 34.5 per cent from 1995 to 2002 in Western Europe. Over the last decade, knitted fabrics and products have been increasingly designed and developed for a very wide spectrum of technical textiles applications, including automotive textiles, medical textiles, geotextiles, sportswear, safety and protective textiles, and environmental protection textiles, just to name a few major growth areas of technical textiles.

Warp and weft knitted spacer materials are being commercially developed for a very wide range of technical textile products, because of a number of unique design opportunities that they offer. Knitted spacer fabrics are a single composite of at least three different substrates integrated together during a single knitting process. The range of materials and structures that are possible are virtually limitless. It is possible to engineer fabrics with specific tailor-made characteristics and thicknesses ranging from 2 mm to 60 mm in warp knitting and 2 mm to 10 mm in weft knitting.

The paper discusses a number of significant developments in both knitting technology and knitted structures for a wide range of specific product applications. Warp and weft knitting spacer technologies will be discussed in depth and their present and future potential will be critically analysed.

It is hoped to demonstrate that both three-dimensional warp and weft knitting technologies have a significant growth potential in the present and future technical textiles markets worldwide.

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Forming of Properties of Heat-Resistant and Anti-Electrostatic Double-Layer Knitwears

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Abstract

The technology of multi-functional knitted materials having barrier properties has been developed on the basis of stuff-structural and technical-technological designing.

Barrier properties of knitwears were formed i.e.by using:

1. For external layers- yarns constructed from:

- 100 % Metaramidefibres and mixed (metaramide and viscose FR) fibres responsible for heat protection properties of the materials.
- Mixed metaramide and anti-electrostatic fibres responsible for heat-protection properties as well as for protection against static electricity.

2. For internal layers- yarns constructed from mixed cotton and wool fibres with the supplementation of viscose FR or modacryle Protex, responsible for heat-protection properties and having beneficial physiological properties.

Complexed studies on structural, physico-mechanical, chemical and applied barrier properties as well as on physiological comfort allowed for:

1. Designing of double-layer and “platered” structures
2. Selection of optimal knitwears useful for construction of multifunctional protection garments on the basis of knitting technology and the final processing
3. Development of designing and construction guidelines as well as the production of protection garments on the basis of the knitwears properties analysis.

Designed garments could be useful as an individual protection resources for workers exposed to harmful occupational environment factors, like heat and static electricity.

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Fusion: The Inis Meain Knitting Company and University of Ulster Collaboration Project

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This paper discusses the impact of work-based learning in education and the importance of developing partnerships between university and industry. This is in the context of the BA (Hons) Textile Art, Design and Fashion Course (Fashion knit) University of Ulster and InisMeain Knitting Company, Galway, Ireland. The paper will discuss the outcome of a recent IntertradeIreland Fusion project, which involved Inis Meain Knitting Company (the Industrial partner) the University of Ulster (the academic partner and knowledge provider) and a recent graduate (the knowledge carrier) [1,2]. The paper will focus on the impact on teaching and learning pedagogy, the knowledge transfer between the tripartite relationship of the industrial partner, academic partner and the graduate. It will consider skill acquisition and the flow of innovation and ideas developed throughout the 12-month project and measurable outcomes recorded in quarterly evaluations evidencing both qualitative and quantitative data. It will also assess the impact on all stakeholders over the prevailing year. Intertrade Ireland describes the Fusion as "An all-island technology transfer programme, which can help you to bolster your business's bottom line and get ahead of the competition by partnering your company with a third-level institution with the specialist expertise you need and a high calibre science, engineering or technology graduate. With innovative training, talented graduates, award-winning knowledge transfer and a strong track record of challenging business thinking, we are well-placed to help your company or organisation to succeed" [1].

Inis Meáin Knitting Company has been described by the financial times as, "A stylish knitwear boutique based where its heritage-rich clothes are made - the Aran Islands It's a far-flung spot for a spending spree, but this knitwear boutique on Inis Mean, one of the three Aran Islands at the mouth of Galway Bay in Ireland, is in a league of its own, being the most westerly and remote shopping destination in Europe" [2]. This investigation into work-based learning and the potential beneficial outcomes for the tripartite stakeholders have been described as, "A class of university programmes that bring together universities and work organisations to create new learning opportunities in workplace. Such programmes meet the needs of learners, contribute to the longer term development of the organisation and are formally accredited as university courses" [3]. The changing landscape of the UK Higher Education sector has identified that in recent years while student numbers continue to increase with widening participation, staff numbers have decreased since 2009. The up-dating of machinery and availability of resources both in technological and human terms has created difficulties for Universities. "Higher Education is in the midst of an unprecedented era of change. Governments are keen to reduce public expenditures. There are demands to increase numbers and diversity of students. Alongside these continuing imperatives looms a crisis in the nature of knowledge for which Universities previously stood" [3].

In conclusion the paper will consider the delivered outcomes for the Industrial partner, academic partner and graduate.

One of the main benefits is the unique input of graduate designers who are eager to extend their knowledge and understanding of the subject area. They have an understanding of trends and if carefully managed can have a real impact on the company and bring interesting, innovative and novel approaches without any preconceptions of accepted norms within the company. The Industrial partner also has the advantage of accessing the equipment and knowledge of the academic partner and all the resources associated within the subject, this can include access to periodicals and a wide range of journals and also websites such as Worth Global Style Network (WGSN) [4]. The academic is able to maintain a design ethos; working with an industrial partner fosters good understanding of current market forces, practices in sales and retail and an insight into design for the curriculum based on current practice. Access to state of the art CAD CAM systems and knitting technology, networking events and in this particular project, designers, buyers, Industrial trade fairs, Yamamoto and Channel design and production teams. Benefits for the student, were seen in increased skill acquisition, understanding of key roles and responsibilities in Industrial approaches to design, cutting edge CAD/CAM technology. Access to all aspects of the design, development, production, manufacture, sales and marketing, promotional activities resulting in a thorough understanding of all aspects of manufacturing and therefore future employability.

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Validation and Analysis of the Computerized Model Developed for the Study of Mechanics of 1x1 Rib Loop Formation Process

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Introduction

In order to gain an insight into the mechanics of 1x1 rib loop formation on dial and cylinder type double jersey machine, computerised model of the same was developed by the author [1-3]. For the same, the geometry of the knitting zone and the geometrical configuration of the rib loop inside knitting zone were developed [1]. The concept of robbing back in single jersey knitting [4], different single jersey loop models [5-7] as well as different knitting tension and force measuring methods [8-12]adopted in single jersey knitting were considered for the modelling including the minimum information available for double jersey knitting [13-16].

The developed computerised model can predict a lot of information about the 1x1 rib loop formation. As ultimate loop length, occurrence and extent of robbing back during loop formation and yarn tension profile are the main output of the model, attempts have been made to validate the developed computerised model in the following manner:

(i) The predicted loop length and occurrence of robbing back have been validated by comparing the actual loop length of 66 number of 1x1 rib knitted fabrics produced under different timing of knitting (synchronised and 2-Needle delayed) in two different double jersey knitting [17].

(ii) An experimental set-up [18] was installed inside the knitting zone of the cylinder for measuring needle butt – cam interactive forces using quartz force link (transducer) and computer (recorder). The profile of measured cam force was compared with the predicted needle butt - cam force profile.

(iii) As the machine in which the cam force measuring set-up was installed could be adjusted up-to 3-Needle delay timing, force measurement experiments were extended also for 1-Needleand 3-Needle delayed timings [19].

(iv) By varying the important input parameters which may affect the mechanics of loop formation, 128 sets of combinations were generated and different relevant output parameters were predicted for those 128 sets of input parameters. Those output parameters were subjected to critical analysis for identifying the critical input parameters of rib loop formation as well as their response to the loop forming system [20].

The degree of matching obtained between predicted and measured values of loop length and cam forces in the study as well as theoretical analysis of the model justify the acceptability of the model developed for the purpose. Loop length in general decreases with increase in yarn tension from synchronised to gradual increase in delay timing. The model can well predict the occurrence of robbing back in rib knitting under both synchronised and two needle delayed timing. The robbing back in rib knitting occurs in two or three phases instead of one as established in single jersey knitting, but the magnitude of robbing back is lesser than single jersey knitting. A very wide range of loop length can be produced in the same rib knitting machine in one hand and same loop length can be produced under different knitting timings under different yarn tension by manipulating the combination of input parameters according to requirement.

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Measurement of Fabric-Take down Force on Double-Bed Circular Knitting Machines

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On a double-bed circular knitting machine with a needle bed diameter 8e″ (200 mm), a machine gauge of E17, which knitted with 8 knitting systems, rib fabrics in basic construction were made. The machine is used to knit cotton knitted fabrics to be used for making children's clothing, especially undershirts and undergarments. Yarns counts from 12 to 36 tex can be used for knitting on the machine. Fabric samples were made from single cotton yarns in counts 16, 20, 24 and 30 tex. When making fabric samples, the optimum machine control for 20 tex yarns was applied. From each yarn 5 samples approximately 2 m long were made and fabric take down force was measured for each sample. When the fabric was removed from the knitting machine, fabric-take down force was measured in various different ways. When making samples from finer yarns, average fabric-take down force amounted to 14,0 cN/needle, and when using coarser yarns it amounted to 22,8 cN/needle. Different measuring conditions provide essentially different average tensile forces for fabric-take down force.

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Electromagnetic Shielding Effectiveness of Conductive Knitted Fabrics

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Abstract

Intensive integration of the technology in human life, and increasing use of electronic devices and instruments cause the emission of electromagnetic waves that results in electromagnetic pollution. Electromagnetic waves are known to have harmful effects on electronic devices as well as human health in different dimensions and therefore many researches work about screening for the prevention of these effects [1].

Electromagnetic shielding effectiveness of the textile surfaces vary depending on type of material that is used [2]. Also it is depending on the structure of textile surface. The aim of this project is to investigate the application of knitted textile materials for the purpose of protection against electromagnetic waves and the effect of raw material, yarn and fabric parameters on electromagnetic shielding properties extensively [3-5]. We used copper and silver filaments and produced core yarns. By using conductive yarns single jersey, rib, and Futter (2 threads) knitted fabrics were produced.

Thereafter the shielding properties of the fabrics were tested by using EMC test system with real electromagnetic waves. Measurements were performed in the Electromagnetic Competence (EMC) Test Device. The testing equipment is composed of a signal generator which produces the signals to be sent onto the sample, an RF power amplifier which amplifies the signals before being sent to the sample, two antennas; one is connected to the signal generator to send the signals to the sample and the other to the spectrum analyzer as receiver and a spectrum analyzer where the data is collected for evaluation. EMSE measurements were measured different frequencies between 100 MHz-1 GHz.

The results show that conductive fabrics have high EMSE (Electromagnetic Shielding Effectiveness) values when compared to cotton fabrics. Futter knitted fabrics show better values when compared to jersey and rib. Also the fabrics that contain copper have high EMSE values.

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